City of Norfolk, Virginia
Department of Utilities

DESIGN CHECKLISTS

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CITY OF NORFOLK
DEPARTMENT OF UTILITIES
DESIGN ENGINEER SUBMISSION FOR WATER AND SEWER PROJECTS

_____
Project Title

____ 1. Virginia registered engineer's stamp, signature, and date.
____ 2. Engineering Report including a System Layout Plan has been submitted.
____ 3. Water System is designed to provide adequate domestic service and fire protection to owner's property. _____" diameter line is required to adequately serve this project in accordance with City Standards.
   a. Average Domestic Design Flow _____
   b. Peak Hour Domestic Flow _____
   c. Design Fire Flow _____
   d. Total Design Peak Flow _____
   e. Residual Pressure at Total Design Peak Flow (last hydrant) _____
____ 4. Sanitary Sewer Service area map is submitted with plans. Sanitary Sewer Analysis is shown on sewer shed map. _____" diameter line is required to adequately serve this project in accord with the City Standards.
   a. Average Daily Flow _____
   b. Design Peak Flow _____
____ 5. This is a phased project. Overall water and sewer plans have been submitted for approval with fire hydrants and valve locations shown.
____ 6. Plan and profile sheets are on 24"336" paper. Drawing organization and format comply with Section 5 of the Department of Utilities Design Criteria.
____ 7. A cover sheet is provided which includes the Owner/Developer name and address, project vicinity map, and Standard Water and Sewer Notes.
____ 8. The sewer drawings include stationing, pipe size, material, bearings, direction of flow, deflection angles, grade and distance between centerline of manholes. Benchmarks are shown every 500 feet.
____ 9. Domestic water meter calculations are shown on plans where applicable in accordance with A.W.W.A. Manual M-22.
____ 10. I.S.O. Fire Flow computations are included (where applicable).
____ 11. All sanitary sewers are profiled. Crossings with other utilities are shown and conflicts resolved.
____ 12. All water mains are profiled. Where water mains of any size cross other utilities, these crossings are profiled, and the means for crossing and resolving any conflicts are clearly shown.
____ 13. Any and all existing sewer and water connections to the property are shown on plans.
____ 14. All proposed water and sewer lines connect to existing water and sewer lines which have been previously accepted by the City for operations and maintenance.
____ 15. All off-site easements necessary for the completion of this project have been acquired, recorded and their Deed Book and Page references are shown on the plans.
____ 16. A list of the Approximate Material Quantities to be used and the latest Material Notes are shown on the plans.
____ 17. A backflow prevention device is provided on domestic and fire service connections in accordance with Part II, Article 3 of the Commonwealth of Virginia, State Board of Health Waterworks Regulations and the City's Cross-Connection Policy.
____ 18. Drawings comply with all applicable Local, State and Federal regulations including City and State erosion control ordinances and application has been made for all required permits.

I have reviewed this Checklist for accuracy and hereby certify that the water and/or sewer plans as submitted have been designed in accord with the latest City Standards, Waterworks Regulations and Sewerage Regulations (whichever is more restrictive). The plans have been reviewed for completeness and accuracy and are herewith submitted for approval.

P.E.

_____ _____
Signature Certificate Number

_____ _____
Name Typed or Printed Date

City of Norfolk, Virginia
Department of Utilities

Sewage Pumping Station
Design Checklist

General Drawing Requirements

_____ 1. The drawings are in accordance with the Standards and use of the Department's standard symbols or an appropriately labeled symbol key.
_____ 2. The drawings are clear and legible.
_____ 3. The City Seal is located adjacent to the front door.
_____ 4. The appropriate applications have been properly filled out and submitted:
   a. HRSD Flow Certification
   b. Portable Equipment Form (VDH)
   c. Dominion Virginia Power Request for Service
   d. Health Department Submittal
_____ 5. Only sanitary wastes are collected and transported – no storm drains or surface water are shown entering the sanitary sewer system.
_____ 6. Any affected wetland areas or Resource Protection Areas (RPA) are properly shown and labeled.
_____ 7. Benchmark(s) are identified on the site plan and located every 500 feet along the route of the new sewer force main(s).
_____ 8. A north arrow and horizontal and vertical scale are included on each sheet, where applicable.
_____ 9. All existing easements are shown accurately and proposed utility easements are shown on drawings. The existing easements reflect accurate record information.
_____ 10. Proposed and existing water and sewer lines are properly labeled with size and type of pipe, and the horizontal and vertical locations shown on the drawings.
_____ 11. All existing and proposed sanitary sewer, storm sewer, gas, telephone, power, any other utility lines, and all water services which cross or run parallel to the sewer line(s), are shown with horizontal and vertical separations given, where applicable. Subsurface exploration has been performed where potential conflicts exist, where applicable.
_____ 12. Adjacent road and drainage projects are shown as required.
_____ 13. Road names, state route numbers, and right-of-way widths are shown.
_____ 14. Stations ascend from left to right.
_____ 15. Proposed sewer lines are shown with reference distances from rights-of-way, boundaries, buildings, other utility lines, etc.
_____ 16. All subdivisions, property lines, and property markers (stones, rods, pins, pipes, monuments, etc.) are shown.

_____ 17. Location of existing houses, buildings, fences, wells and other structures are shown on drawings. In lawn or kept areas, trees and shrubs in the easements are shown (size and type).

_____ 18. All designs conform to the latest City and State erosion and sediment control rules, regulations, and ordinances.

_____ 19. The Design Engineer has coordinated the utility design and construction work with other Design Engineers where their projects connect or affect each other.

_____ 20. Locations of special features (concrete encasement, rip-rap stabilization at creek crossings, clay dams, etc.) are shown in sufficient detail.

_____ 21. All fill and cut areas are shown within the area of the existing and proposed sewer line(s).

_____ 22. Necessary easement plats onsite and/or offsite have been submitted in accordance with the Norfolk City Surveyor's Requirements for processing.

_____ 23. Pavement replacement and/or landscaping details are shown on all drawings.

_____ 24. Proposed and existing ground elevations are shown.

_____ 25. Contract Documents (drawings and specifications) have been submitted to the State Health Department for review and approval where applicable. A copy of transmittal letter is attached to checklist.

_____ 26. Alignment of utility in existing Virginia Department of Transportation (VDOT) right-of-way is consistent with City and VDOT guidelines. A copy of a transmittal letter to VDOT for their review is attached. The Design Engineer understands that a letter of approval from VDOT is required prior to final utility plan approval.

_____ 27. All sanitary sewer drawings are labeled with size, grade, length, direction of flow, and type and class of pipe(s) (with backup calculations on the type & class pipe needed, where applicable).

_____ 28. Manholes are labeled with rim and invert elevations; coordinates; and locations, size and inverts of drop stacks.

_____ 29. Deflection angles at all manholes or bearings of all lines are shown on the drawings.

_____ 30. Manholes are spaced a maximum of 300 feet apart.

_____ 31. All minimum finished floor elevations and basement elevations are to be shown on drawings, where applicable.

_____ 32. Ground coverage over sewer pipe meets the minimum criteria of 36-inches.

_____ 33. Is emergency pump connection shown and does it conform to standard detail?

_____ 34. Is an adequate buffer zone shown around the pumping station?

_____ 35. Is there an ample driveway that allows for the largest Department of Utilities vehicle to access the pumping station?

Wet Well Drawing Requirements

_____ 36. Is the wet well access hatch easily accessible and free from obstructions?
_____ 37. Are the bar screen and emergency bypass channel shown and are they easily accessible for maintenance?
_____ 38. Are the alarm levels and elevations shown?
_____ 39. Is the wet well designed to prevent solids deposition?
_____ 40. Is the wet well designed to prevent free-fall of sewer influent during normal operation?
_____ 41. Is there an isolation valve on the sewer influent line located in a valve vault outside of the wet well?
_____ 42. Is all interior metal Type 316L stainless steel?
_____ 43. Are all electrical fixtures in the wet well explosion-proof?
_____ 44. Are there appropriate flow-measuring device(s) and pressure recording device(s) shown?
_____ 45. Is an appropriate coating specified for the interior of the wet well?

Pump Room Drawing Requirements

_____ 46. Is there sufficient (minimum 3 feet) clearance between pieces of equipment, pipes, and structural elements?
_____ 47. Is there sufficient access and handling equipment to facilitate removal and reinstallation of pumps and motors? Does the beam extend through the door to facilitate loading and unloading?
_____ 48. Is the sump pump properly sized with the discharge into the wet well above the wet well high-level elevation?
_____ 49. All lights and switches easily accessible?
_____ 50. All valve operators shall be accessible from the pump room floor or stair landing.
_____ 51. Is there an appropriate backflow prevention device on any potable water supply line?
_____ 52. Is there a gate valve on the suction line?
_____ 53. Is there a check valve and a gate valve on the discharge line?
_____ 54. Is the control system in accordance with Department Standards?
_____ 55. Is there sufficient lighting? Is the lighting shielded?

Design Considerations

_____ 56. Does the pumping station meet the requirements of Class I Reliability?
_____ 57. Has a capacity analysis of the influent collection system been completed in accordance with the Department Standards?
_____ 58. Has a pump sizing analysis been completed in accordance with the Department Standards?

_____ 59. If the pumps are larger than 50 hp, has the Design Engineer performed a cost analysis to determine if three or more pumps is more cost effective for the Department?

_____ 60. Has the system curve been determined and transposed to a manufacturer's pump performance curve?

_____ 61. Has hydraulic transient control been considered by the Design Engineer?

_____ 62. Has a ventilation analysis been completed to ensure proper air changes in the wet well and the pump house?

_____ 63. Is the lifting equipment properly sized for the largest piece of equipment in the pumping station?

_____ 64. Has the effect of hydraulic thrust been considered and addressed?

City of Norfolk, Virginia
Department of Utilities

Wastewater Collection System
Design Checklist

Drawing Requirements

_____ 1. The drawings are in accordance with the Standards with the use of the Department's standard symbols or an appropriately labeled symbol key.
_____ 2. The drawings are clear and legible.
_____ 3. Only sanitary wastes are collected and transported – no storm drains or surface water are shown entering the sanitary sewer system.
_____ 4. Any affected wetland areas or Resource Protection Areas (RPA) are properly shown and labeled.
_____ 5. Benchmark(s) are identified on the site plan and located every 500 feet along the route of the new sewer line(s).
_____ 6. A north arrow and horizontal and vertical scale are included on each sheet, where applicable.
_____ 7. All existing easements are shown accurately and proposed utility easements are shown on drawings. The existing easements reflect accurate record information.
_____ 8. Proposed and existing water and sewer lines are properly labeled with size and type of pipe, and the horizontal and vertical distances shown on the drawings.
_____ 9. All existing and proposed sanitary sewer, storm sewer, gas, telephone, power, any other utility lines, and all water services which cross or run parallel to the sewer line(s), are shown with horizontal and vertical separations given, where applicable. Subsurface exploration has been performed where potential conflicts exist, where applicable.
_____ 10. All existing sewer laterals are shown on the drawings, with station, length and depth, as depicted on the record drawings.
_____ 11. A minimum of ten (10) feet horizontal separation is maintained between sewer lines; between sewer lines and water lines and appurtenances; and between sewer lines and storm drainage structures.
_____ 12. Adjacent road and drainage projects are shown as required.
_____ 13. Consideration has been given to areas where roads and drainage structures may be lowered in the future.
_____ 14. Road names, state route numbers, and right-of-way widths are shown.
_____ 15. Stations ascend from left to right.
_____ 16. Proposed sewer lines are shown with reference distances from rights-of-way, boundaries, buildings, other utility lines, etc.
_____ 17. All subdivisions, property lines, and property markers (stones, rods, pins, pipes, monuments, etc.) are shown.

_____ 18. Location of existing houses, buildings, fences, wells and other structures are shown on drawings. In lawn or kept areas, trees and shrubs in the easements are shown (size and type).

_____ 19. All designs conform to the latest City and State erosion control and sedimentation rules, regulations, and ordinances.

_____ 20. The Design Engineer has coordinated the utility design and construction work with other Design Engineers where their projects connect or affect each other.

_____ 21. Locations of special features (concrete encasement, rip- rap stabilization at creek crossings, clay dams, etc.) are shown in sufficient detail.

_____ 22. Detail drawings of all stream crossings are included, with elevations of the streambed, 100-year flood elevation, and normal water elevation shown.

_____ 23. All fill and cut areas are shown within the area of the existing and proposed sewer line(s).

_____ 24. Necessary easement plats onsite and/or offsite have been submitted for processing.

_____ 25. Pavement replacement and/or landscaping details are shown on all drawings.

_____ 26. Proposed and existing ground elevations are shown.

_____ 27. All revisions from previous submittals include an explanation either on the drawings or by separate transmittal.

_____ 28. Contract Documents (drawings and specifications) have been submitted to State Health Department for review and approval where applicable. A copy of transmittal letter is attached to checklist.

_____ 29. If horizontal bore is required, bore location, length of bore, pit location are shown in relation to all existing and/or proposed utilities on plan and profile.

_____ 30. Alignment of utility in existing Virginia Department of Transportation (VDOT) rights-of-way is consistent with City and VDOT guidelines. A copy of a transmittal letter to VDOT for their review is attached. The Design Engineer understands that a letter of approval from VDOT is required prior to final utility plan approval.

_____ 31. All sanitary sewer drawings are labeled with size, grade, length, direction of flow, and type and class of pipes (with backup calculations on the type & class pipe needed, where applicable).

_____ 32. Manholes are labeled with top and invert elevations; coordinates; and locations, size and inverts of drop stacks.

_____ 33. Deflection angles at all manholes or bearings of all lines are shown on the drawings.

_____ 34. All sewer lines are designed with the entry into the manhole by the proposed sewer lines at an angle of 90° or greater to the downstream line. If an exception has been granted, the Design Engineer has increased the drop through the manhole to compensate for the reduced angle and has provided a blowup detail for the appropriate invert shaping that achieves the same results as a 90° or greater entry.

_____ 35. The Design Engineer has field verified the inverts of the existing manhole(s). Where invert elevations are different from the record drawings, the Design Engineer has verified his survey work and notified the Department of the discrepancy.

_____ 36. All manholes are designed to an elevation above the 100-year flood plain elevation or provided with watertight inserts as set forth in the design standards, unless otherwise approved by the Utilities Department. Reference all manholes in easements.

_____ 37. Manholes are spaced a maximum of 300 feet apart.

_____ 38. A NOTE stating that the contractor must field verify the inverts of all existing manholes, gas lines, other utility lines prior to the start of construction.

_____ 39. The Design Engineer has provided the manhole number as reflected on the record drawings at all existing manholes.

_____ 40. All pipe between manholes are of like material and class.

_____ 41. Where new manholes are proposed over existing lines, distance from the new manhole to the two existing manholes is shown; inverts of the manhole and each existing manhole are shown; slope of existing line from new manhole to upstream and downstream existing manholes is shown.

_____ 42. All minimum finished floor elevations and basement elevations are to be shown on drawings, where applicable.

_____ 43. Ground coverage over sewer pipe meets the minimum criteria of 36 inches.

_____ 44. The Design Engineer has identified where the sewer laterals must be installed in accordance with the standard details.

_____ 45. Where future extensions are necessary, these lines are reflected on the drawings.

Design Factors

_____ 46. The sewer system is designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection for the proposed service area.

_____ 47. A sewerage drainage area map and a completed hydraulic analysis table are included with the drawings.

_____ 48. The table in the design standards has been used to determine average daily sewage flow. Any deviations from the table are documented and are based on sound engineering judgment.

_____ 49. The peak sewage flow is determined from the chart in the design standards.

_____ 50. The Design Engineer has provided computations that indicate the slopes on the sewer lines produce a minimum velocity of three feet per second.

_____ 51. The minimum size pipe in the sewer system is eight (8) inches.

_____ 52. Head loss calculations are provided and in accordance with the design standards.

_____ 53. The Design Engineer has investigated the potential for hydrogen sulfide attack and has provided appropriate protection of the sewer system.

_____ 54. The Design Engineer has addressed special circumstances such as water crossings, road crossings, sewers in inaccessible areas, etc., in accordance with the design standards.

_____ 55. The sewer main is designed such that all service connections have a slope of not less than ¼ inch per foot.

City of Norfolk, Virginia
Department of Utilities

Water Distribution System
Design Checklist

Drawing Review

_____ 1. The drawings are in accordance with the Standards with the use of the Department's standard symbols or an appropriately labeled symbol key.
_____ 2. The drawings are clear and legible.
_____ 3. No cross-connections to unapproved water facilities are shown on the drawings.
_____ 4. Any affected wetland areas or Resource Protection Areas (RPA) are properly shown and labeled.
_____ 5. Proposed and existing water and sewer lines are properly labeled with size and type of pipe, and the horizontal and vertical distances shown on the drawings.
_____ 6. Benchmark(s) are identified on the site plan and located every 500 feet along the route of the new water line(s).
_____ 7. A north arrow and horizontal and vertical scale are included on each sheet, where applicable.
_____ 8. All existing easements are shown accurately and proposed utility easements are shown on drawings. The existing easements reflect accurate record information.
_____ 9. All existing and proposed sanitary sewer, storm sewer, gas, telephone, power, any other utility lines, and all water and sewer services which cross or run parallel to the water line(s), are shown with horizontal and vertical separations given, where applicable. Subsurface exploration has been performed where potential conflicts exist, where applicable.
_____ 10. A minimum of eighteen (18) inches of vertical clearance has been designed and obtained at all crossings of other utilities, or as specified by other utility agencies, or otherwise approved by the Department.
_____ 11. Adjacent road and drainage projects are shown as required.
_____ 12. Consideration has been given to areas where roads and drainage structures may be lowered in the future.
_____ 13. Road names, state route numbers, and right-of-way widths are shown.
_____ 14. Stations ascend from left to right.
_____ 15. Proposed water line(s) are shown with reference distances from rights-of-way, boundaries, buildings, other utility lines, etc.
_____ 16. All subdivisions, property lines, and property markers (stones, rods, pins, pipes, monuments, etc.) are shown and identified.

_____ 17. Location of existing houses, buildings, fences, wells and other structures are shown on drawings. In lawn or kept areas, trees and shrubs in the easements are shown (size and type).

_____ 18. All designs conform to the latest City and State erosion control and sedimentation rules, regulations, and ordinances. Erosion and sediment control devices are shown on the drawings.

_____ 19. The Design Engineer has coordinated the utility design and construction work with other Design Engineers where their projects connect or affect each other.

_____ 20. Locations of special features (concrete encasement, rip-rap stabilization at creek crossings, clay dams, etc.) are shown in sufficient detail.

_____ 21. Detail drawings of all stream crossings are included, with elevations of the streambed, 100-year flood elevation, and normal water elevation shown.

_____ 22. All fill and cut areas are shown within the area of the existing and proposed water line(s).

_____ 23. Necessary easement plats onsite and/or offsite have been submitted for processing.

_____ 24. Pavement replacement and/or landscaping details are shown on all drawings.

_____ 25. Proposed and existing ground elevations are shown.

_____ 26. All revisions from previous submittals include an explanation either on the drawings or by separate transmittal.

_____ 27. Contract Documents (drawings and specifications) have been submitted to State Health Department for review and approval where applicable. A copy of transmittal letter is attached to checklist.

_____ 28. If horizontal bore is required, bore location, length of bore, pit location are shown in relation to all existing and/or proposed utilities on plan and profile.

_____ 29. Alignment of utility in existing Virginia Department of Transportation (VDOT) right of ways is consistent with City and VDOT guidelines. A copy of a transmittal letter to VDOT for their review is attached. Design Engineer understands that a letter of approval from VDOT is required prior to final utility plan approval.

_____ 30. Main line valves are shown at intervals not greater than 1000 feet and at tees and crossings. One less valve than the number of mains at tees and crosses may be allowed if Design Engineer demonstrates adequate flow control.

_____ 31. Water mains 16 inches and smaller are shown a minimum of 10 feet from any part of a structure. Water mains larger than 16 inches are shown a minimum of 20 feet from a structure.

_____ 32. All water lines less than 24 inches in diameter have a minimum depth of cover of 36 inches. All water lines 24 inches and greater have a minimum depth of cover of 42 inches.

_____ 33. The location of fire hydrants have been coordinated with the Fire Department by the Department of Utilities. Fire hydrant locations comply with design guidelines

_____ 34. Fire hydrants and air relief valves are shown on plans and profile.

_____ 35. Hydrants or blow-off valves are designed at major low places in the line where possible and air release valves are designed at the high points.

_____ 36. Blowoff devices (flushing hydrants) or fire hydrants are designed at the end of all lines in cul-de-sacs. Location of hydrants comply with guidelines outlined in design standards

_____ 37. All proposed water services are shown in accordance with the design standards.

_____ 38. Line location is shown 5' from face of curb or 2' off pavement where there is ditch.

_____ 39. Ditch lines are shown on the drawings and depth of ditch(es) are shown on the profile at the fire hydrant locations and service lines, where necessary.

_____ 40. Water line stubs for future extensions are designed to be installed beyond the edge of pavement.

_____ 41. Location of water meter boxes are shown outside of non-vehicular traveled areas, driveways, and sidewalks. The boxes are shown on the edge of the right-of-way in the center of the lot.

_____ 42. For water line tie-ins, the Design Engineer has shown the valve to be used for cut off during the tie-in. Where tapping the main line vs. cutting in a tee is applicable, the Design Engineer has evaluated the proper method to be used.

_____ 43. Valves and sample taps are located at both ends of under water crossings. The pipe specified is appropriate for water crossings and has flexible watertight joints.

_____ 44. Water lines crossing over surface water are adequately supported, protected from freezing, are accessible for maintenance, and are located above the 100-year flood elevation.

Design Factors

_____ 45. The Design Engineer has developed a tabular analysis of the total number of people proposed to be served based on existing zoning. The analysis assumes full build-out of the proposed service area.

_____ 46. Average, maximum day, maximum hour, and fire flows have been developed for areas and sub-areas and tabulated in the report

_____ 47. The system is designed to maintain a minimum pressure of 20 psi in the distribution system at the design flow, but no more than 80 psi at any service tap.

_____ 48. All mains are looped and there are no dead-ends. Where dead-ends are unavoidable, an appropriate hydrant or blowoff is provided.

_____ 49. Hydraulic modeling information is provided with all design assumptions clearly indicated.

_____ 50. Fire flows at hydrants have been calculated and are in accordance with design standards and applicable codes.

_____ 51. Design Engineer has designed the water system in accordance with available pressures and has provided fire flow and pressure calculations

_____ 52. Where pipe size is not determined by the Utilities Department, line size calculations are included with the drawings verifying that available pressures meet the required minimum standards.

_____ 53. Minimum sized water line is 6 inches for single-family residential areas and 8 inches for multi-family residential, commercial, and industrial areas.

_____ 54. Appropriate joint restraints are shown and design calculations with summary table are provided that show restraint length requirements.

_____ 55. Steel casing requirements have been considered and design conforms to design standards and standard details.

_____ 56. Service and meter sizing calculations are provided and conform to the design standards.

_____ 57. Appropriate corrosion protection has been considered. For pipe sizes greater than 24 inches, a corrosion specialist has been consulted.

City of Norfolk, Virginia
Department of Utilities

Large Diameter Pressure Pipe (>16")
Design Checklist

Drawing Review

_____ 1. The drawings are in accordance with the Standards with the use of the Department's standard symbols or an appropriately labeled symbol key.
_____ 2. The drawings are clear and legible.
_____ 3. No cross-connections to unapproved water facilities are shown on the drawings.
_____ 4. Any affected wetland areas or Resource Protection Areas (RPA) are properly shown and labeled.
_____ 5. Proposed and existing water and sewer lines are properly labeled with size and type of pipe, and the horizontal and vertical distances shown on the drawings.
_____ 6. Benchmark(s) are identified on the site plan and located every 500 feet along the route of the new water line(s).
_____ 7. A north arrow and horizontal and vertical scale are included on each sheet, where applicable.
_____ 8. All existing easements are shown accurately and proposed utility easements are shown on drawings. The existing easements reflect accurate record information.
_____ 9. All existing and proposed sanitary sewer, storm sewer, gas, telephone, power, any other utility lines, and all water and sewer services which cross or run parallel to the water line(s), are shown with horizontal and vertical separations given, where applicable. Subsurface exploration has been performed where potential conflicts exist, where applicable.
_____ 10. A minimum of eighteen (18) inches of vertical clearance has been designed and obtained at all crossings of other utilities, or as specified by other utility agencies, or otherwise approved by the Department.
_____ 11. Adjacent road and drainage projects are shown as required.
_____ 12. Consideration has been given to areas where roads and drainage structures may be lowered in the future.
_____ 13. Road names, state route numbers, and right-of-way widths are shown.
_____ 14. Stations ascend from left to right.
_____ 15. Proposed water line(s) are shown with reference distances from rights-of-way, boundaries, buildings, other utility lines, etc.
_____ 16. All subdivisions, property lines, and property markers (stones, rods, pins, pipes, monuments, etc.) are shown and identified.

_____ 17. Location of existing houses, buildings, fences, wells and other structures are shown on drawings. In lawn or kept areas, trees and shrubs in the easements are shown (size and type).

_____ 18. All designs conform to the latest City and State erosion control and sedimentation rules, regulations, and ordinances. Erosion and sediment control devices are shown on the drawings.

_____ 19. The Design Engineer has coordinated the utility design and construction work with other Design Engineers where their projects connect or affect each other.

_____ 20. Locations of special features (concrete encasement, rip-rap stabilization at creek crossings, clay dams, etc.) are shown in sufficient detail.

_____ 21. Detail drawings of all stream crossings are included, with elevations of the streambed, 100-year flood elevation, and normal water elevation shown.

_____ 22. All fill and cut areas are shown within the area of the existing and proposed water line(s).

_____ 23. Necessary easement plats onsite and/or offsite have been submitted for processing.

_____ 24. Pavement replacement and/or landscaping details are shown on all drawings.

_____ 25. Proposed and existing ground elevations are shown.

_____ 26. All revisions from previous submittals include an explanation either on the drawings or by separate transmittal.

_____ 27. Contract Documents (drawings and specifications) have been submitted to State Health Department for review and approval where applicable. A copy of transmittal letter is attached to checklist.

_____ 28. If horizontal bore is required, bore location, length of bore, pit location are shown in relation to all existing and/or proposed utilities on plan and profile.

_____ 29. Alignment of utility in existing Virginia Department of Transportation (VDOT) right of ways is consistent with City and VDOT guidelines. A copy of a transmittal letter to VDOT for their review is attached. Design Engineer understands that a letter of approval from VDOT is required prior to final utility plan approval.

_____ 30. Main line valves are shown at intervals not greater than 1000 feet and at tees and crossings. One less valve than the number of mains at tees and crosses may be allowed if Design Engineer demonstrates adequate flow control.

_____ 31. Water mains are shown a minimum of 20 feet from a structure.

_____ 32. All water lines 24 inches and greater have a minimum depth of cover of 42 inches.

_____ 33. The location of fire hydrants has been coordinated with the Fire Department by the Department of Utilities. Fire hydrant locations comply with design guidelines

_____ 34. Fire hydrants and air relief valves are shown on plans and profile.

_____ 35. Hydrants or blow-off valves are designed at major low places in the line where possible and air release valves are designed at the high points.

_____ 36. Blowoff devices (flushing hydrants) or fire hydrants are designed at the end of all lines in cul-de-sacs. Location of hydrants comply with guidelines outlined in design standards

_____ 37. All proposed water services are shown in accordance with the design standards.

_____ 38. Line location is shown 5' from face of curb or 2' off pavement where there is ditch.

_____ 39. Ditch lines are shown on the drawings and depth of ditch(es) are shown on the profile at the fire hydrant locations and service lines, where necessary.

_____ 40. Water line stubs for future extensions are designed to be installed beyond the edge of pavement.

_____ 41. Location of water meter boxes are shown outside of non-vehicular traveled areas, driveways, and sidewalks. The boxes are shown on the edge of the right-of-way in the center of the lot.

_____ 42. For water line tie-ins, the Design Engineer has shown the valve to be used for cut off during the tie-in. Where tapping the main line vs. cutting in a tee is applicable, the Design Engineer has evaluated the proper method to be used.

_____ 43. Valves and sample taps are located at both ends of under water crossings. The pipe specified is appropriate for water crossings and has flexible watertight joints.

_____ 44. Water lines crossing over surface water are adequately supported, protected from freezing, are accessible for maintenance, and are located above the 100-year flood elevation.

Design Factors

_____ 45. The Design Engineer has developed a tabular analysis of the total number of people proposed to be served based on existing zoning. The analysis assumes full build-out of the proposed service area.

_____ 46. Average, maximum day, maximum hour, and fire flows have been developed for areas and sub-areas and tabulated in the report

_____ 47. The system is designed to maintain a minimum pressure of 20 psi in the distribution system at the design flow, but no more than 80 psi at any service tap.

_____ 48. All mains are looped and there are no dead-ends. Where dead-ends are unavoidable, an appropriate hydrant or blowoff is provided.

_____ 49. Hydraulic modeling information is provided with all design assumptions clearly indicated.

_____ 50. Fire flows at hydrants have been calculated and are in accordance with design standards and applicable codes.

_____ 51. Design Engineer has designed the water system in accordance with available pressures and has provided fire flow and pressure calculations

_____ 52. Where pipe size is not determined by the Utilities Department, line size calculations are included with the drawings verifying that available pressures meet the required minimum standards.

_____ 53. Appropriate joint restraints are shown and design calculations with summary table are provided that show restraint length requirements.

_____ 54. Steel casing requirements have been considered and design conforms to design standards and standard details.

_____ 55. Service and meter sizing calculations are provided and conform to the design standards.

_____ 56. Appropriate corrosion protection has been considered. For pipe sizes greater than 24 inches, a corrosion specialist has been consulted.

City of Norfolk, Virginia
Department of Utilities

Easement Processing Checklist

General Requirements

_____ 1. Has the Design Engineer investigated all options to use existing public rights-of-way or existing easements for the proposed utility?

_____ 2. Has an entire easement survey been completed and plat developed?

_____ 3. Are all lines of proposed construction tied to existing property lines and/or corners?

_____ 4. Are permanent easements a minimum of 20 feet wide?

_____ 5. Will the easement provide adequate space to maintain the utility or replace the utility while existing line remains in service, if necessary?

_____ 6. Are water and/or sewer lines the only utilities shown located in the easement?

_____ 7. If a temporary or construction easement is being requested, is there ample room for construction traffic?

_____ 8. Is the submittal signed and sealed by a state of Virginia registered land surveyor or engineer?

Easement Submission Requirements

_____ 9. Does the Legal Description Sheet meet the requirements of the City Code and the Standards?

_____ 10. Is the property being taken clearly described and the owner identified?

_____ 11. Are metes and bounds descriptions clear and concise? (Note: No coordinates shall be included in the legal description)

_____ 12. Is adjacent property clearly described and identified?

_____ 13. Does the Property Plat meet the requirements of the City Code and the Standards?

_____ 14. Are there appropriate bearings, distances, etc., shown on the drawings?

Easement Review Checklist

1. Applicant to submit two copies of easement legal description and sketch for Department review.

_____ Approved
_____ Disapproved – returned with corrections noted

2. Department determines if other City agencies may be affected. If so, additional copies shall be sent to the affected agencies.

_____ Forwarded to other agency(ies)
_____ Not forwarded – sent to Survey

3. Forward legal description and sketch to Department of Public Works Survey for review and approval.

_____ Approved
_____ Disapproved – returned with corrections noted

4. If approved by the Survey Division, forward legal description and sketch to City Attorney's office for review, approval, and recording.

_____ Approved
_____ Disapproved – returned with corrections noted

5. Applicant notified of approval or disapproval.

_____ Approved
_____ Disapproved – returned with corrections noted

City of Norfolk, Virginia
Department of Utilities

New Product Review Procedure

The following procedure has been developed to assist the Department of Utilities in properly investigating and evaluating new products and technologies.

I. Product Review Board

1. **Establish a New Product Review Board**. The review board should consist of representatives from Engineering, Operations, Maintenance, and Construction Inspection. Other departments may be invited depending on the product(s) under review. The members of the review board will act as the spokespersons for their department. The members will be responsible for prioritizing the products to be investigated, investigating new products, and making recommendations for approval or rejection of products or processes. The Product Review Board should meet at least monthly. This Board shall be responsible for maintaining a Department of Utilities approved products list.

2. **Identify products for review**. Prior to each meeting, the board members shall solicit input from their divisions and identify products, equipment, or technologies to investigate. The items selected may be based on problems or issues in operations and/or maintenance, problems or issues in construction, or items found in trade magazines, trade shows, word of mouth, etc. The board will review the items and prioritize products to review.

II. Product Review Process

1. **Review process for specific products**.

    a. **Gather information**. If the product to be reviewed is from a specific manufacturer, one board member is tasked with collecting catalog information and contacting the vendor to set up a demonstration or brief presentation. This presentation could be done at a review board meeting or as a lunchtime presentation with several individuals from the various departments. A sample of questions the vendor should be asked include:

        1. What are the recommended applications?
        2. Why is this product an improvement over our existing product(s)?
        3. How long has the product been on the market?
        4. Where has it been used in the local area? Can a site visit be scheduled?
        5. Does the product have any local, state or national certifications?
        6. What maintenance or operation issues have been reported?

7. What is the recommended maintenance? Are parts available locally? Any special tools or equipment needed to maintain?
8. How much does it cost? How does this relate to similar products? Why is this the best value?
9. Can you provide a list of references of municipal users of this product for us to contact?
10. Is there any special training required either for installation or maintenance?
11. What kind of product warranty is available? Is there an extended warranty? If so, how much?
12. What is the expected life of the product? Under what conditions is the life shortened?

b. **Check References**. After the presentation, one board member is assigned to check references. If a site visit is possible, the board member should organize a visit for key personnel to see the product in use.

c. **Review Findings**. The assigned board member shall report the product review findings to the board. If an unfavorable review is given and agreed upon by the board, the product is removed from consideration. If a favorable review is given, a trial test will be recommended.

d. **Trial Period**. After a favorable review, the product should be purchased and incorporated into a typical existing facility or facilities. The procurement of the product should include any training and associated technical representative assistance needed. The installation of the product can be either by in-house forces or by a Contractor. The trial period is conducted under normal operating conditions. During the trial period, a logbook shall be kept in a suitable, easy-to-find location. The product should be routinely inspected and the results documented. Any maintenance or problems shall also be documented in the logbook. The duration of this trial period and the frequency of inspections will vary depending on the product being tested.

e. **Final Approval**. After the trial period, the Review Board should review the logbook and any comments from field personnel. An unfavorable review may lead to more testing or a decision to deny the product for Department use. A favorable review will allow the product to be placed on the Approved Product List and to be included in specifications for future projects.

2. **Review process for general products or technologies**

The process is similar to that outlined above for specific products, except that the information gathering phase is more involved. There may be a need to canvass the industry in search of a better product for a particular application. For

example, gate valves are currently used for shut-off valves on the discharge and suction lines at all sewage pumping stations. The review board may be asked to determine if there is another type of valve that may provide better service. In these cases, the Review Board must determine what other products may be applicable. Possible reference sources include:

1. Other municipalities
2. Trade Magazines
3. Internet search
4. Vendors
5. Consultants
6. Contractors

After all of the possible products are determined, a review process similar to paragraphs a. through e. above should be conducted to determine the applicability of any new product.

City of Norfolk, Virginia
Department of Utilities

Suggested Sewer Rehabilitation Design Decision Procedure

The following written procedure is to be used in conjunction with the attached decision logic flowchart. This flowchart considers many of the general elements involved in a sewer rehabilitation project and assists the Design Engineer in evaluating the feasibility of the various options. The user of this document should note that it is very difficult to generalize engineering design matters without endangering the final product. This document and the attached flowchart are not intended to replace sound engineering judgment. Engineers should consider the applicability of the contents of this document to specific projects and, based on the characteristics and requirements of the projects make the necessary adjustments as required. In choosing the most suitable pipe rehabilitation method the individual considerations presented below need to be evaluated comprehensively for site specific conditions.

1. **CCTV or Digital Imaging sewer inspection and evaluation.** In order to determine the condition of the existing sewer pipe, a detailed visual inspection is required. Inspections by personnel entry may be feasible in larger pipelines (48" and above). However, in most cases, personnel access into smaller sewer pipes is not feasible and not preferable due to the confined space and obvious safety and health issues. In these cases, CCTV or the newer digital imaging technology is the preferred method to visually inspect the pipe. Either of these techniques can be used to verify the structural integrity of the pipe, identify sources of infiltration, assess the condition lateral connections and pipe joints, and other features that may affect the integrity and flow characteristics of the pipe. The evaluation of the pipeline is generally rated according to the National Association of Sewer Service Companies (NASSCO) assessment guidelines.

2. **Structural Integrity.** The internal visual investigation will assist in determining several important design considerations, the most important of which is the structural condition of the pipe. Many of the trenchless techniques are not recommended if there are partial or full collapses of the existing pipe. In most cases, if there are partial or full collapses of the host pipe, pipe bursting or dig and replace are the preferred methods. The visual inspection can also determine if there are any major sags in the existing pipe due to poor bedding conditions or if there is adequate slope of the pipeline. Again, trenchless techniques generally cannot resolve major sags or poor slope conditions because they assume the form of the host pipe. Dig and replace is often the preferred (or only) method that can resolve these issues.

   Root intrusion, poor or offset joints, and poor lateral or manhole connections are other important defects to note and evaluate, which may affect the structural integrity of the overall collection system. These defects can generally be resolved with trenchless rehabilitation techniques.

3. **Flow Characteristics.** After the visual inspection of the pipe is completed, a hydraulic analysis of the collection system is recommended. The hydraulic analysis should consider whether the existing pipe is sufficient for current and projected flow conditions. In general, if the pipe requires 75% or more of its existing flow capacity, the improved flow characteristics of a rehabilitated pipe should be calculated. If the improved flow conditions of a rehabilitated pipe still indicate a need for 75% or more of the existing flow capacity, consideration should be given to upsizing the pipeline either through dig and replace or pipe bursting. If the analysis shows that the pipe size is sufficient but the diameter cannot be reduced, sliplining, Shotcrete, or other spray on liners that reduce the diameter are generally not feasible and can be eliminated from consideration.

4. **Service Connections.** The quantity and location of the service connections must be carefully considered. Numerous service connections and service connections that enter the main at odd angles can be time consuming and expensive to reconnect or rehabilitate robotically from inside the pipe. Some trenchless techniques – in particular sliplining and pipebursting - require the lateral connections to be reestablished by digging and replacing.

5. **Bends In Host Pipeline**. Any bends that may be present in the sewer line between manholes can make trenchless methods more difficult to successfully rehabilitate the pipe. Techniques such as CIPP, Fold and Form, cement mortar, and chemical and epoxy coatings may be used if the bend is not severe and the host pipe is in reasonably good condition. However, sliplining and pipebursting are not as flexible and generally not as effective even with minor bends in the pipeline. The higher cost and feasibility of these methods should be considered.

6. **Surface Access**. The accessibility of the host pipe is the next consideration. If the pipe is greater than 10 feet deep, issues such as higher cost and safety become limiting factors for the dig and replace option. If the pipe is not accessible from the surface, or the cost to access the pipe is too great (i.e. the pipe is located under a major thoroughfare with numerous utilities in the immediate vicinity that would require a lengthy road closure), the dig and replace method may be eliminated and consideration given to the trenchless techniques.

7. **Existing Utilities**. In most mature cities there may be numerous utilities in close proximity to the sewer main located in the right-of-way or utility easement. In areas with a large number of utility lines, it may not be feasible to dig and replace. Pipebursting may also be eliminated as an option if there is a chance the vibration may affect the surrounding utilities.

8. **Bypass pumping**. Nearly all the techniques to rehabilitate sewer pipelines require some level of bypass pumping or flow diversion to be successful. Some techniques, such as dig and replace and sliplining can be properly installed with a small degree of flow in the collection system. However, other techniques such as

CIPP, Fold and Form, and pipebursting generally require, and result in a better-finished product, if there is no flow in the pipeline. For this reason, the feasibility of bypass pumping is an important aspect to consider.

9. **Access Pit**. Some trenchless techniques do require some surface disruption at each or one end of the line to be rehabilitated, typically at the manhole locations. Sliplining and pipebursting both require access pits, while the other techniques can be performed through an existing or new manhole. Consideration must be given as to whether the existing site will allow an access pit because of traffic and pedestrian impacts, location of the manhole, and location of existing facilities. If an access pit is not feasible, sliplining and pipebursting can generally be eliminated as options.

10. **Existing Soil Conditions.** Pipebursting is one trenchless technique that may have an impact on the surrounding utilities and surrounding soil. If a sewer is less than four feet deep and/or constructed in poor soil that is not conducive to tunneling or vibrational impacts, pipebursting may not be a feasible choice.

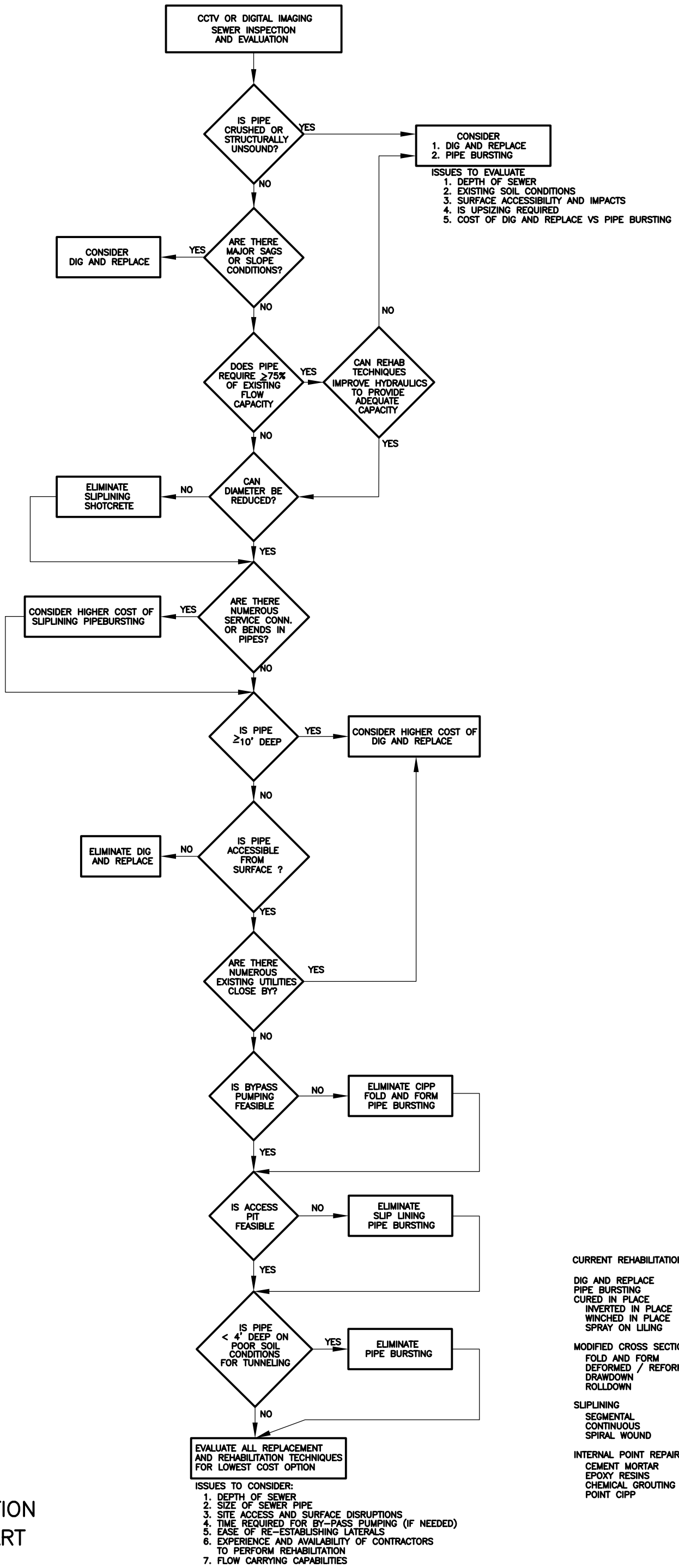
11. **Other issues to consider.** After the visual pipe inspection, hydraulic analysis, and site conditions are considered; a decision can be made as to what will provide the best value and best service for the longest period of time. A cost benefit analysis can be done evaluating each of the various methods of sewer rehabilitation. Factors to consider include, but are not limited to:

    a. Depth of sewer
    b. Size of pipe
    c. Site access
    d. Impacts from surface disruptions (both financial impacts and "good neighbor" impacts)
    e. Time required for bypass pumping or flow diversion
    f. Quantity and method of service reestablishment
    g. Experience and availability of local contractors to perform each method

Decision. The final decision will be based on what provides the greatest value to the overall collection system at the least cost. Some situations may require a combination of several methods. For example, a pipe with numerous leaky joints and one partial collapse may require a dig and replace point repair at the partially collapsed section before sliplining the entire pipe. Regardless of the rehabilitation technique that is ultimately chose, each situation must be evaluated systematically using a procedure similar to the outline herein to determine the best engineering solution. The following table is a comparison of the various sewer rehabilitation methods:

COMPARISON OF TRENCHLESS METHODS

Method	Advantages	Disadvantages
CIPP	Can go over irregularities	Bypass or diversion of flow required
	Durable	Must allow adequate curing time
	Good at reducing I&I	Defective installation may be difficult to rectify
	Superior flow characteristics	Reduces pipe diameter
	High corrosion resistance	Cannot increase size
Modified Cross Section	Can go over irregularities	Bypass or diversion of flow required
	Good at reducing I&I	The cross section may shrink or unfold after expansion
	Superior flow characteristics	Reduces pipe diameter
	High corrosion resistance	Infiltration may occur between liner and host pipe unless sealed
	Less expensive than CIPP	Liner may not provide adequate structural support
		Defective installation may be difficult to rectify
Pipe Bursting	Can go over irregularities	Bypass or diversion of flow required
	Can increase size	Insertion pit required
	Good at reducing I&I	Percussive action can cause significant ground movement
	Superior flow characteristics	May not be suitable for all materials
	High corrosion resistance	Non-reinforced pipe only
		Major impact to laterals - generally requires open cut
Sliplining	Good at reducing I&I	Insertion pit required
	Superior flow characteristics	Reduces pipe diameter
	High corrosion resistance	Not well suited for small diameter pipes
		Infiltration may occur between liner and host pipe unless sealed
		Major impact to laterals - generally requires open cut
		Difficult to vary alignment
		Difficult to grout annular space



SEWER REHABLILTATION DECISION FLOWCHART

CURRENT REHABILITATION TECHNIQUES

DIG AND REPLACE
PIPE BURSTING
CURED IN PLACE
- INVERTED IN PLACE
- WINCHED IN PLACE
- SPRAY ON LILING

MODIFIED CROSS SECTION METHODS
- FOLD AND FORM
- DEFORMED / REFORMED
- DRAWDOWN
- ROLLDOWN

SLIPLINING
- SEGMENTAL
- CONTINUOUS
- SPIRAL WOUND

INTERNAL POINT REPAIRS
- CEMENT MORTAR
- EPOXY RESINS
- CHEMICAL GROUTING
- POINT CIPP

City of Norfolk, Virginia
Department of Utilities

Plan of Development Application Requirements for Department of Utilities

_____ 1. Cover sheet requires Virginia Professional Engineer seal with original signature and date.

_____ 2. Utility projects are designed in accordance with Department of Utilities' Standards.

3. The following information is included with the application:

_____ a. Preliminary Engineering Report

_____ b. Sewer Design Form

_____ c. Water system hydraulic calculations and model information

_____ d. Fire flow estimate

_____ e. Traffic Control Plan

_____ f. E&S Plan? (if appropriate)

_____ 4. For phased projects, an overall water and sewer Master Plan for construction and acceptance of water and sewer facilities is required.

5. Drawings in plan view shall include the following information:

_____ a. Location of all existing private utilities and all existing proposed public water and sanitary sewer facilities including all pipe sizes, pipe class or grade, materials, grades and/or profiles as required by the Dept. of Utilities Standards Manual; and all proposed connections to County or other utility systems

_____ b. Standard size sheet, 24" x 36", with topographic map of sewer service area. The map shall show location of site in relation to adjacent properties. The map shall show the location of existing sewer mains, the proposed connections to the existing system, routing of mains from the existing system to the site, and any future sewer lines and easements necessary to serve the proposed development and off-site properties.

_____ c. Standard size sheet, 24" x 36" with water service area to show site in relation to adjacent properties. The map shall show the location of existing water mains, the proposed connections to the existing system, routing of mains from the existing system to the site, and any future water lines necessary to serve the development and offsite properties.

_____ 6. Profiles - inverts and elevations of any utility and drainage facilities that cross the proposed water and sewer mains shall be profiled and conflicts adequately resolved.

_____ 7. Show existing and proposed utility easements including public service corporation easements.

_____ 8. Location of existing and proposed private water and sewage treatment facilities including wells, water storage tanks, septic tanks and drain fields shall be indicated.

9. Adequacy of fire protection shall be addressed.

_____ a. Show proposed fire hydrants, including closest existing fire hydrants in vicinity of site.

_____ b. Provide appropriate fire flow computations for commercial, industrial or multi-family development.

_____ c. Provide hydraulic calculations and model information indicating the system capacity and pressure available to serve this site from existing mains.

_____ 10. Plans shall indicate required state or federal permits and list any required exceptions to the Standards. All required permits and exceptions shall be approved prior to approval of any plan for construction.

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